Neonatal encephalopathy; early MRI assessment

A Thesis submitted for partial fulfillment of M.D. degree in Radiodiagnosis

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DEDICATION

To My Beloved Husband, ***Dr. Bassem Ezzat Georgy,*** *Consultant of Radiodiagnosis, your love and support made me reach this day and for you I dedicate every success I achieve in my life.*

To ***My Beloved Mother****, because of you I'm here today, Wish you and* ***My Father*** *are proud of me*

I am indebted to ***My family*** *and* ***My friends*** *for their endless and continuous help and support.*

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ABSTRACT:

Many preterm and some full tern newborns show different abnormal clinical signs during or soon after birth that may indicate the presence of encephalopathy which could be caused by hypoxic, metabolic or infectious etiologies. Determining the presence of insult, its underlying cause and its extent is very critical as it dramatically affect the management of such neonates.

Magnetic resonance (MR) imaging is the most sensitive technique for assessing the developing brain providing highly detailed images of brain structures without exposing infants to ionizing radiation or health risks; it is increasingly used in clinical practice as the main imaging method for detecting neonatal brain injury.

In neonates and young infants, the standard MRI protocol consist ofT1 and T2-weighted images (WIs) as well as axial diffusion or diffusion tensor images**.** DWI sequences are very sensitive for detecting acute HIE, whereas gradient (GRE) sequences can detect the smallest amount of hemorrhage

KEY WORDS:

Neonate, HIE, PLIC, Metabolic, Infection.

CONTENTS

LIST OF ABBREVIATIONS

AA: Amino Acids

ADC: Apparent diffusion coefficient

AR: Autosomal Recessive

BP: Blood Pressure

CBF: Cerebral blood flow

Cho: Choline

CMV: Cytomegalovirus

CNS: Central Nervous System

Cr: Creatine

CSO: Centrum Semiovale

DTI: Diffusion Tensor Imaging

DWI: Diffusion weighted image

Fig: Figure

GA: Gestational Age.

GE: Gradient echo

Glx: Glutamine + Glutamate

GM: Germinal Matrix

GMH: Germinal Matrix Hemorrhage

GRE: Gradient Echo

HIE: Hypoxic Ischemic Encephalopathy

IR: Inversion Recovery

IUGR: Intra uterine growth retardation

IVH: Intra-ventricular Hemorrhage.

MR: Magnetic Resonance

MRA: Magnetic resonance angiography

MRI: Magnetic resonance imaging

MRS: Magnetic Resonance Spectroscopy

MSU: Maple Syrup Urine disease

NAA: N acetyl aspartate

NE: Neonatal Encephalopathy

NICU: Neonatal Intensive Care Unit

PCI: Parasagittal Cerebral Injury

PLIC: Posterior Limb of Internal Capsule

PPV: positive-predictive value

PUK: Phenylketonuria

PVL: Periventricular Leukomalacia

SE: Spin echo

SNN: Selective Neuronal Necrosis

SNR: Signal to noise ratio

TCUS: Trans Cranial Ultrasound

US: ultrasound

WI: Weighted image

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INTRODUCTION

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Neonatal encephalopathy is a clinically defined syndrome of disturbed neurologic function in the earliest days of life, manifested by a subnormal level of consciousness or seizures, and often accompanied by difficulty with initiating and maintaining respiration and depression of tone and reflexes. ***(D'Alton et al., 2014)***

Neonatal encephalopathy may result from hypoxic-ischemic injury (by far the most common cause), infectious diseases, metabolic disorders, trauma, and congenital disorders. ***(Shroff et al., 2010).*** It accounts for 15-28% of children with cerebral palsy. ***(Chao, 2006)***

We use the term hypoxic-ischemic injury to designate any brain impairment caused by insufficient oxygenation and blood flow. This term should not be confused with hypoxic-ischemic encephalopathy (HIE), a condition that is diagnosed on the basis of specific clinical findings of profound acidosis, a poor Apgar score (0–3) at birth, seizure, coma, hypotonia, and multi-organ dysfunction. ***(Shroff et al., 2010)***

HIE clinically presents within a few hours of birth with encephalopathy and can affect preterm as well as term infants. Clinical features such as history of peri-partum asphyxia, neonatal resuscitation, seizures and abnormal neurological status are indicative of HIE and require further assessment with imaging. Late clinical findings can vary from mild neurological impairment to severe neurological deficits, seizures and developmental delay. Imaging findings depend on severity of ischemic insult, maturity

of the neonatal brain, and time elapsed between the onset of injury and the imaging effort ***(Badve et al., 2012)***

Accurate prediction of neurodevelopmental outcome in neonatal encephalopathy (NE) is important for clinical management and to evaluate neuro-protective therapies. ***(Thayyil et al., 2010)***

It is crucial to consider the clinical history when interpreting MR studies of encephalopathic neonates: The gestational age at birth is predictive of the pattern of hypoxic-ischemic injury, with the pattern in preterm infants (those with a gestational age of less than 36 weeks) differing from that in full-term neonates (those with a gestational age of 36 weeks or more). ***(Shroff et al., 2010)***

Cranial ultrasonography and computed tomography lack sensitivity for the evaluation of the nature and extent of brain injury in the term encephalopathic infant. ***(D'Alton et al., 2014)***

Magnetic resonance (MR) imaging is the most sensitive technique for depicting the developing brain. Because it can provide highly detailed images of brain structures without exposing infants to ionizing radiation and associated health risks, it is increasingly used in clinical practice as the main imaging method for detecting neonatal brain injury. ***(Shroff et al., 2010)***

Most neonatal MR studies are performed by using 1.5-T systems, although the availability of 3.0-T systems (with inherently higher signal to noise ratio SNR and magnetic susceptibility) is increasing. ***(Shroff et al., 2010)***

In neonates and young infants, the standard MRI protocol consists of T1 and T2-weighted images (WIs) as well as axial diffusion or diffusion tensor images. ***(Girard et al., 2012)***

DWI sequences are very sensitive for detecting acute HIE, whereas gradient (GRE) sequences can detect the smallest amount of hemorrhage. ***(Badve et al., 2012)***

The use of dedicated MR-compatible incubators with built-in coils can save considerable time in transport and improve patient safety. ***(Shroff et al., 2010)***

AIM OF THE STUDY:

The aim of the study is to assess the different MR patterns seen in neonatal encephalopathy.

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